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U.S. Army Aviation Epidemiology Data Register: Incidence and Age-specific Rates of Herniated Nucleus Among U.S. Army Aviators, 1987-1992

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The U.S. Army Aviation Epidemiology Data Register (AEDR) was queried for listings of Army aviators with the finding of herniated nucleus pulposus (HNP) for the 6-year period of 1987 to 1992. This study tabulated the incidence, age-specific annual rates of HNP, and the distribution of aeromedical dispositions for aircrew with HNP. The U.S. Army aviation medicine community can expect an annual incidence rate about 1 case of HNP per 1,000 aviators years. However, the incidence rate is increasing. Aviators about age 40 were at the greatest risk. About 7.4 percent of the aviators with HNP were removed permanently from Army flying duties due to HNP complications.

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Military relevance

Herniated nucleus pulposus (HNP) is a common cause of spinal pain and disability in the general population. Among aviators, the annual incidence and age-specific rates of HNP and risk of aeromedical termination from aviation service due to HNP are unknown. Study of the U.S. Army Aviation Epidemiology Data Register (AEDR) provided an analysis of HNP rates and outcomes in the U.S. Army aviator population.

Background

The operative experience of a single U.S. Air Force orthopedic clinic focused on HNP in flying military personnel. Sixty-six flying personnel underwent surgical treatment for HNP, with 22.7 percent being cervical HNPs and 77.3 percent lumbar. Presurgical trauma history, duration and pattern of symptoms, and surgical complications were described. Eighty-eight percent were returned to flying duties in a variety of tanker-bomber aircraft and the F-106 fighter aircraft (Myers, 1964).

A clinic for civilian flying personnel in Romania noted that during a 10-year period, 77 personnel were evaluated for suspected lumbar HNP. Of those, 14 had HNP and root syndrome, with 4 requiring surgical intervention. A few case histories were presented (Galiani et al., 1982).

Among 68 military flying personnel referred to a central diagnostic facility for chronic back pain, none had HNP. However, the authors concluded that radiologic survey for HNP was indicated in flying personnel with chronic back pain, especially if there was a history of back trauma (Delahaye, Pannier, and Tabusse, 1975).

Case-history studies relate high-G exposure to cervical HNP and bulging cervical intervertebral disks. Among eight cases of F-15 and F-16 aircrew members with cervical spine symptoms due to or aggravated by $+G_Z$ forces, three had HNPs at C5-6 and C6-7 (Schall, 1989). Among three cases of F-16B aircrew members who developed acute onset of neck pain during high-G maneuvers, two had bulging cervical intervertebral disks by magnetic resonance imaging (MRI). One had an HNP at C6-7, which required surgical intervention to decompress the spinal cord (Hamalainen et al., 1994).

Methods

All of the AEDR components were searched for records with ICD9-CM codes related to the finding of degenerative disc disease, herniated nucleus pulposus, lumbago, radiculopathy, and surgical procedures related to the spine. The search was for calendar years 1987 through 1992. The subjects were all U.S. Army aviators, to include Army civilian pilots. We reviewed the aeromedical board documents and consolidated AEDR medical histories for each case matching the search codes. Selected data elements were abstracted for analysis. These elements included Social Security

number, spinal level of the HNP, complications, procedures, medications, and other spinal findings. Other elements derived from the time of diagnosis included age, gender, component of service, height, weight, rotary- and fixed-winged flying hours, and final aeromedical disposition.

The diagnosis of HNP was defined as surgical evidence of HNP, and/or evidence of HNP by radiologic imaging combined with signs and symptoms consistent with the diagnosis of HNP. Cases with only degeneration of the spinal disc or bulging without herniation by radiologic or surgical examination were excluded. Final case selection was made by the first author.

An "aviator-year" was defined as an individual aviator undergoing a FDME in 1 calendar year. The aviator was assumed to be in the follow up cohort for that entire calendar year.

The relative risk with confidence intervals was calculated using the method of Katz (Kahn and Sempos, 1989). Rates were calculated using a computer spreadsheet program.

Results

The average annual incidence rate of HNP among Army aviators was about 1 per 1,000 aviator-years per year. Table 1 shows the incidence rate by calendar year. The incidence rate increased by fivefold from 1987 to 1992.

Table 1.
Incidence rate of HNP per 1,000 Army aviator-years by calendar year.

Calendar year	Aviator-years	N	Incidence
1987	22,477	11	0.49
1988	22,417	12	0.54
1989	22,092	11	0.50
1990	21,830	16	0.73
1991	21,694	31	1.43
1992	19,653	51	2.60

Table 2 shows the annual rate of HNP per 1,000 aviator-years by age at diagnosis, grouped in 5-year intervals. Middle-aged aviators were at the highest risk for the new diagnosis of HNP.

Table 2.
Annual rate of HNP per 1,000 Army aviator-years by age at diagnosis.

Age at diagnosis	Mean annual aviator-years 1987 to 1992	N	Annual rate
20-24	1,065	0	0.00
25-29	4,651	14	0.50
30-34	4,529	16	0.59
35-39	3,854	35	1.51
40-44	4,782	46	1.60
45-49	2,036	15	1.23
50-54	536	3	0.93
55-59	187	3	2.68
60-72	39	0	0.00

Among the 132 aviators, 25.8 percent had cervical HNPs, 74.2 percent had lumbar HNPs, and none had thoracic HNPs as shown in Table 3. Operative management was required in 66.6 percent of cases. Those with cervical HNPs were not at increased risk for operative management compared to those with lumbar HNPs (RR=0.961, $CI_{0.95}$=0.723,1.28).

Table 3.
Comparison of the required treatment for aviators with cervical and lumbar HNP.

HNP level	Operative	Nonoperative	N
Cervical HNP	22	12	34
Lumbar HNP	66	32	98
N	88	44	132

The final aeromedical disposition could not be determined in 7.5 percent of the aviators since they retired from aviation service coincidental with the timing of their HNP diagnosis and treatment. Among the remaining 122 aviators, 92.6 percent returned to aviation service with a waiver, as shown in Table 4.

Table 4.
Aeromedical disposition outcomes of aviators with cervical and lumbar HNP.

Outcome	Cervical HNP	Lumbar HNP	N
Disqualified, left service	3	7	10
Medical suspension	2	7	9
Waiver recommended	29	84	113
N	34	98	132

Discussion

The incidence of HNP among U.S. Army aviators is increasing for unknown reasons. There was no change in aeromedical policy or disease reporting requirements related to HNP during the interval of the study. The increase in incidence rates may be due to the previously documented increase in the number of middle-aged aviators in our work force during the study period (Mason and Shannon, 1994; Shannon and Mason, 1994). It may be due to the increasing availability of MRI during the last few years as a new diagnostic tool for HNP.

Although HNP is accompanied often by disabling pain and neurologic deficits, we observed the chance for returning to flying duties after surgical or conservative management is good. This agrees with the similar findings of other authors (Myers, 1964).

There were no prior studies suitable for comparison to our findings. Most studies were limited to describing individual parameters, such as HNP by level, operative outcome, and conservative management outcome; but not together as in this study. Most studies failed to provide denominators, such as population size and age distribution. Most studies were limited to case-control studies of hospital referral populations, rather than investigations of primary care populations, such as a cohort of truck drivers in a large company with a system of reporting all major illnesses in the cohort.

Summary

HNP is an infrequent cause of medical disability among U.S. Army aviators, with an average annual incidence rate of 1 per 1,000 aviator-years per year over 6 years of observation. The incidence of HNP among U.S. Army aviators is increasing for unknown reasons. We speculate that this may be due to the increasing age of our cohort and/or due to the increased availability of MRI as a new diagnostic tool for HNP during the study period. Fortunately, the majority of aviators with HNP respond to surgical and/or conservative management, and are returned to flying duties.

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